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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/820,272	04/08/2004	Tatsuo Suemasu	105-63 DIV/RCE II	8591
23869 7590 02/14/2011 HOFFMANN & BARON, LLP 6900 JERICHO TURNPIKE SYOSSET, NY 11791				
EXAMINER				
BAREFORD, KATHERINE A				
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/820,272

Applicant(s)

SUEMASU ET AL.

Examiner

Katherine A. Bareford

Art Unit

1715

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 December 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 9, 11, 13-16, 18 and 20-28 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 9, 11, 13-16, 18 and 20-28 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-940)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on December 9, 2010 has been entered.

The amendment filed with the RCE submission of December 9, 2010 has been received and entered. With the entry of the amendment, claims 1-8, 10, 12, 17 and 19 are canceled, and claims 9, 11, 13-16, 18 and 20-28 (including new claims 23-28) are pending for examination.

Terminal Disclaimer

2. The terminal disclaimer filed on December 12, 2008 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent granted on application number 11/739,575 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 24 and 27 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

New claims 24 and 27 provide that "the molten metal is solidified in a state where the substrate is in the chamber where the inert gas is fed." However, the disclosure as filed, see specification, page 19, for example, simply provides that "Once the substrate 10 is lifted out of the plating solution 20, the substrate 10 is cooled to solidify the plating solution 20 filled into the through holes 11. . .". There is no indication or requirement that this cooling and solidification is done in the chamber where the inert gas is fed. Therefore, these claims contain new matter.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 25 and 28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 25 and 28 provide that "molten metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor". However, it is unclear when wettability is considered to be "poor" as opposed to "good" or "average". Is it a specific degree of wettability as compared to some other area of the surface? Is it simply any place where the molten metal drops off (that is, if the metal drops off, the wettability is poor)? Is it something else? For the purpose of examination, any of these is considered to read on the claims, however, applicant should clarify what is intended, without adding new matter.

Claim Objections

7. The objection to claims 10 and 17 to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim is withdrawn due to the cancellation of claims 10 and 17 in the amendment of December 9, 2010.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

10. Claims 9, 11 and 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan 04-206875 (hereinafter '875) in view of Amano (US 5289038), Schneble, Jr. et al (US 3628999) and Stynes (US 4071878).

Claims 9,11: '875 teaches that it is well known to provide a metal filling method for semiconductor elements, where a semiconductor substrate such as GaAs is provided and non-through hole is formed with extends from a first surface towards an opposite surface of a substrate. See figure 1(c), pages 1, 5 of translation (hole 4). A metal layer is formed on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate, and on the portion of the first surface of the substrate

adjacent to the non-through hole. Figure 1(d), pages 1, 4 of translation (Ti/ Au film 6 formed on the hole 4 and around the hole 4). Then the non-through hole is filled with molten metal and the molten metal is allowed to solidify. Figure 1 (e), (f) and page 5 of translation (softened gold 7 would be at least suggested to be molten, because it must be in a condition of being softened by heat as opposed to solidified, and softened would be inclusive of molten). Then part of the substrate is removed such that the solidified metal is exposed through the opposite surface of the substrate. Figure 1(h) and page 5 of translation.

Claim 13: part of the substrate is removed by polishing. Page 1 of translation ("processed by polishing").

Claim 14: the solidified metal comprises an external section which protrudes from the first surface of the substrate. Figure 1(g).

Claim 15: the external section comprises a bump. Figure 1(g).

'875 provides all the features of these claims except that (1) before forming the inner layer an oxide layer is formed on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate and on a portion of the first surface of the substrate adjacent to the non-through hole, such that only the oxide layer is layered on the substrate, (2) filling the hole with molten metal by using the decompression chamber as claimed, (3) filling the hole with molten metal by immersing the substrate in molten metal (claim 10), and (4) then solidifying the metal by discharging the substrate from the molten metal (claim 11).

However, Amano teaches that when providing semiconductor substrates with non-through holes to which metal filling is provided, it is well known to provide a first layer of oxide (insulation film 22 of silica) directly on the substrate in the hole (concave) area and on a portion of the substrate adjacent this area. Figure 2 and column 4, line 40 through column 5, lines 35. Then a metal film 23 is provided directly on the insulation film 22 in the hole (concave) area and a portion of film 22 adjacent the hole area. Column 5, lines 25-35 and figure 2. Then, over that area the metal filling area 26 is provided. Column 5, lines 5-15.

Schneble teaches a metal filling method. Column 4, lines 40-75. A hole is formed in a work piece extending from a first surface towards and opposite surface of a work piece. Column 4, lines 55-60 (holes 28) and figure 1E. The hole extends "into" base 10, and is not required to pass entirely through the substrate (base). Column 4, lines 55-50 and Figure 1. Then a metal layer is formed on at least an inner surface of one end of the hole adjacent the first surface of the work piece. Column 4, lines 55-65 (deposit 30) and figure 1F. The metal layer is also formed on a portion of the first surface of the work piece adjacent the hole, and thus is directly adhered to the first surface of the work piece adjacent the hole. Column 4, lines 60-70, column 5, lines 5-15 and figure 1F (land 32 on the top of mask layer 26 of the work piece, note that the hole is formed in a "work piece" that has base 10 and layers 22, 24, 26 as shown in figure 1E, and thus the top of mask layer 26 is the "first surface" of the work piece; to which the metal layer is directly adhered to (stuck fast or attached) until the layer 26 is actually removed as in figure 1G,

column 4, lines 65-70). Then a third step of filling a molten metal into the fine hole is provided. Column 4, lines 65-75, column 5, lines 25-30 (solder would be metal) and Figure 1H (see 34). These form conductive passageways (connectors). Column 2, lines 40-50. The hole is filled by immersing the work piece in molten metal. Column 2, lines 1-10, column 4, lines 65-75, column 5, lines 20-60 (dipping in a molten solder bath). The solder metal comprises an external section which protrudes from the first surface of the work piece, forming a "bump" shape. Figure 1H and column 4, lines 70-75.

Stynes teaches that a known desirable immersion way of filling holes in electrical articles such as capacitors or circuit boards (column 2, lines 20-25 and column 13, lines 5-15) with molten metal is to provide the molten metal in a vessel (decompression chamber), reduce the pressure in the chamber, and then lower the substrate into the molten metal, thus immersing the substrate in the molten metal, followed by pressurizing the chamber to force (flow) the molten metal into the holes (electrode regions) in the substrate, and then the substrate is withdrawn from the molten metal and allowed to cool to solidify the molten metal therein (see figures 11, 6 and 23, and column 5, line 20 through column 6, line 68). Stynes indicates that the holes can be through holes or not-through holes (column 5, lines 20-30, access through the top and/or bottom (if only from one not a through hole), and column 13, lines 35-60, holes pass through the top and/or the bottom, that is access can be only from the top or bottom, and thus not a through hole, and Figures 20, 21, see leads/holes marked 143, 144, for example, without through passage, column 13, lines 20-25).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 to provide an oxide insulation film in the non-through hole and adjacent the non-through hole, directly on the substrate and under the area where the metal layer is provided as suggested by Amano with an expectation of providing a desirable insulation between the semiconductor substrate and the metal layer as '875 teaches providing a metal layer between a semiconductor substrate and filled metal of a hole area and Amano teaches that when providing a metal layer between a semiconductor substrate and filled metal of a hole area it is well known to further provide an oxide insulation layer between the semiconductor substrate and the metal layer. It would further have been obvious to modify '875 in view of Amano to provide the metal filling method by immersing the work piece in molten metal as suggested by Schneble with an expectation of desirable metal filling results, because '875 in view of Amano provides filling metal in a non-through hole after the hole area has an oxide layer followed by a metal layer; and Schneble provides a known way to fill a non-through hole with a metal layer on the inside with a metal fill. It would further have been obvious to modify '875 in view of Amano and Schneble to further remove the work piece from the molten metal bath and solidify the molten metal, in order to have a desirable treated substrate for use, because '875 in view of Amano and Schneble teaches to dip the article in molten metal, and demonstrates the result of a plated and filled article, indicating that the article must be removed from the molten metal bath for final use and furthermore the molten metal would solidify after removed from the bath,

because it was no longer heated. Moreover, it would further have been obvious to modify '875 in view of Amano and Schneble to provide the immersion filling process by providing the molten metal in a decompression chamber, reducing the pressure in the chamber, then immersing the substrate in the molten metal, and then after immersion, pressurizing the chamber so that the molten metal flows into the inside of the hole, and then removing the substrate and allowing the molten metal to solidify as suggested by Styne in order to provide desirable impregnation of the holes, because '875 in view of Amano and Schneble provides impregnation of molten metal into the holes by immersion, and Styne teaches that when impregnating molten metal into holes in electrical articles by immersion, it is known to provide the filling process by providing the molten metal in a decompression chamber, reducing the pressure in the chamber, then immersing the substrate in the molten metal, and then after immersion, pressurizing the chamber so that the molten metal flows into the inside of the hole, and then removing the substrate and allowing the molten metal to solidify in order to provide a desirable entry of the metal in to these holes.

11. Claims 16, 18 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano, Schneble and Styne as applied to claims 9, 11 and 13-15 above, and further in view of Locke et al (US 5245751).

'875 in view of Amano, Schneble and Styne teaches all the features of these claims except (1) that the hole is a through hole that extends through the work piece

(claim 16) and that the metal filling method further comprises closing the opening of the through holes and then opening the closed opening (claim 16), (2) and the closing of the opening using sealing material (claim 20).

Locke teaches that it is well known to provide connector through holes in an article where the holes are to be filled with metal. Column 4, lines 5-20. Locke teaches that it is known to form the connectors by providing a via or hole 82 that extends partially into a substrate (layer 80) of a work piece. Figure 6a and column 8, lines 20-30. Then the hole is plated to fill with conductor metals. Figure 6b and column 8, lines 25-35. Then the substrate 80 is partially removed to expose the metal in the hole by a process such as etching. Figure 6c and column 8, lines 35-40. Solder can be plated into the holes. Column 8, lines 40-45. Locke also teaches that it is known to form the connectors by providing a through hole 58 through a substrate (sheet 56) and to close/block/seal the hole using a layer 54 (copper foil). Figure 5a and column 7, lines 40-47. Then the hole is plated to fill with conductor metals. Column 7, lines 45-55 and figure 5b. Then the layer 54 is removed to expose the metal through the opening of the through hole. Figure 5c and column 7, lines 54-60.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano, Schneble and Stynes to provide a through hole that extends through the entire work piece but is blocked by a sealing layer (closing one side of the opening) to allow desirable filling and then to open the closed opening by removing the sealing layer as suggested by Locke in order to provide

desirable connectors, because '875 in view of Amano, Schneble and Stynes teaches to provide holes into the substrate to be filled with metal and that the holes will become through holes and Locke teaches that when providing connector holes, it is known to provide them as a through hole that extends through the entire work piece but is blocked by a sealing layer (closing one side of the opening) to allow desirable filling, and then to open the closed opening by removing the sealing layer, which would provided an equivalent through hole system result to that provided by '875 in view of Amano, Schneble and Stynes. It would have been obvious to that the sealing layer would be provided either before or after hole formation with an expectation of equivalent results as long as it was provided before the filling of the holes, because the purpose of the sealing layer is to block the opening during filling. Also note In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946) (selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results) (MPEP 2144.04. IV. C).

12. Claims 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano, Schneble and Stynes as applied to claims 9, 11 and 13-15 above, and further in view of Ishikawa et al (US 3599601).

'875 in view of Amano, Schneble and Stynes teaches all the features of these claims except (1) the chamber pressurized by feeding an inert gas (claim 23) and (2) lifting the substrate from the molten metal so that metal drops off in areas other than

the metal layer where the wettability of the molten metal with respect to the substrate is poor (claim 25). Stynes teaches that the molten metal is solidified in a state where the substrate is in the chamber where pressurized (column 6, lines 55-60).

Ishikawa provides an immersion process for filling pores (holes) of a porous substrate with molten metal (column 1, lines 5-10), where molten metal is provided in a vessel (decompression chamber), the pressure is reduced in the chamber, the substrate is then lowered into the molten metal, thus immersing the substrate in the molten metal (column 4, lines 20-40, figure 4), followed by pressurizing the chamber to provide for impregnation of the substrate (column 4, lines 40-50). The pressurizing the chamber is done by feeding inert gas under pressure into the chamber (column 4, lines 40-50), with the inert gas preventing the metal and substrate from oxidizing (column 4, lines 20-30). After impregnation, the substrate is lifted from the molten metal and can be cooled in the chamber while under pressure (column 4, lines 45-65, figure 5). The lifting of the substrate out from the molten metal allows excess metal attached thereto to be removed (column 4, lines 50-55).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano, Schneble and Stynes to use inert gas to provide the pressurization in the decompression chamber as suggested by Ishikawa in order to prevent oxidation of substrate or molten metal since Stynes provides a desirable impregnating process for the substrate holes using immersion in molten metal under pressure in a chamber, and Ishikawa teaches that pressure when

impregnating holes with molten metal using immersion in a molten metal under pressure in a chamber can be desirably provided by feeding inert gas which prevents oxidation of the metal and substrate. When using such inert gas in the chamber, the solidification in the chamber as provided by Stynes would be in the chamber where the inert gas is fed. It further would have been obvious to one of ordinary skill in the art to modify '875 in view of Amano, Schneble and Stynes to provide that the lifting out of the substrate provides that molten metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor as suggested by Ishikawa, in order to provide a desirably coated article, because Stynes teaches lifting the substrate out of the molten metal bath after immersion and impregnation (figure 11, column 6, lines 54-60), and Ishikawa shows that when lifting a substrate out of a molten metal bath after immersion in a molten metal bath under pressure to impregnate, it is well known for excess metal attached thereto to be removed, that is, drops off, which indicates that the area from which it drops off from the substrate would have poor wettability to the extent claimed (note the 35 USC 112 confusion as to what is required by poor wettability), and further given the suggested use of a semiconductor substrate such as GaAs by both '875 and applicant (page 12 of the specification), it would also be expected that the same poor wettability and metal drop off would occur, since, "Products of identical chemical composition can not have mutually exclusive properties." A chemical composition and its properties are inseparable. Therefore, if the prior art teaches the identical chemical structure, the properties applicant discloses

and/or claims are necessarily present. In re Spada, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990).

13. Claims 26-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano, Schneble, Stynes and Locke as applied to claims 16,18 and 20-22 above, and further in view of Ishikawa et al (US 3599601).

'875 in view of Amano, Schneble, Stynes and Locke teaches all the features of these claims except (1) the chamber pressurized by feeding an inert gas (claim 26) and (2) lifting the substrate from the molten metal so that metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor (claim 28). Stynes teaches that the molten metal is solidified in a state where the substrate is in the chamber where pressurized (column 6, lines 55-60).

Ishikawa provides an immersion process for filling pores (holes) of a porous substrate with molten metal (column 1, lines 5-10), where molten metal is provided in a vessel (decompression chamber), the pressure is reduced in the chamber, the substrate is then lowered into the molten metal, thus immersing the substrate in the molten metal (column 4, lines 20-40, figure 4), followed by pressurizing the chamber to provide for impregnation of the substrate (column 4, lines 40-50). The pressurizing the chamber is done by feeding inert gas under pressure into the chamber (column 4, lines 40-50), with the inert gas preventing the metal and substrate from oxidizing (column 4, lines 20-30). After impregnation, the substrate is lifted from the molten metal and can be cooled in

the chamber while under pressure (column 4, lines 45-65, figure 5). The lifting of the substrate out from the molten metal allows excess metal attached thereto to be removed (column 4, lines 50-55).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano, Schneble, Stynes and Locke to use inert gas to provide the pressurization in the decompression chamber as suggested by Ishikawa in order to prevent oxidation of substrate or molten metal since Stynes provides a desirable impregnating process for the substrate holes using immersion in molten metal under pressure in a chamber, and Ishikawa teaches that pressure when impregnating holes with molten metal using immersion in a molten metal under pressure in a chamber can be desirably provided by feeding inert gas which prevents oxidation of the metal and substrate. When using such inert gas in the chamber, the solidification in the chamber as provided by Stynes would be in the chamber where the inert gas is fed. It further would have been obvious to one of ordinary skill in the art to modify '875 in view of Amano, Schneble, Stynes and Locke to provide that the lifting out of the substrate provides that molten metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor as suggested by Ishikawa, in order to provide a desirably coated article, because Stynes teaches lifting the substrate out of the molten metal bath after immersion and impregnation (figure 11, column 6, lines 54-60), and Ishikawa shows that when lifting a substrate out of a molten metal bath after immersion in a molten metal bath under

pressure to impregnate, it is well known for excess metal attached thereto to be removed, that is, drops off, which indicates that the area from which it drops off from the substrate would have poor wettability to the extent claimed (note the 35 USC 112 confusion as to what is required by poor wettability), and further given the suggested use of a semiconductor substrate such as GaAs by both '875 and applicant (page 12 of the specification), it would also be expected that the same poor wettability and metal drop off would occur, since, "Products of identical chemical composition can not have mutually exclusive properties." A chemical composition and its properties are inseparable. Therefore, if the prior art teaches the identical chemical structure, the properties applicant discloses and/or claims are necessarily present. In re Spada, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990).

14. Claims 9, 11, 13-15 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Japan 04-206875 (hereinafter '875) in view of Amano (US 5289038), Schneble, Jr. et al (US 3628999) and Japan 2002-158191 (hereinafter '191).

Claims 9,11: '875 teaches that it is well known to provide a metal filling method for semiconductor elements, where a semiconductor substrate such as GaAs is provided and non-through hole is formed with extends from a first surface towards an opposite surface of a substrate. See figure 1(c), pages 1, 5 of translation (hole 4). A metal layer is formed on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate, and on the portion of the first surface of the substrate

adjacent to the non-through hole. Figure 1(d), pages 1, 4 of translation (Ti/ Au film 6 formed on the hole 4 and around the hole 4). Then the non-through hole is filled with molten metal and the molten metal is allowed to solidify. Figure 1 (e), (f) and page 5 of translation (softened gold 7 would be at least suggested to be molten, because it must be in a condition of being softened by heat as opposed to solidified, and softened would be inclusive of molten). Then part of the substrate is removed such that the solidified metal is exposed through the opposite surface of the substrate. Figure 1(h) and page 5 of translation.

Claim 13: part of the substrate is removed by polishing. Page 1 of translation ("processed by polishing").

Claim 14: the solidified metal comprises an external section which protrudes from the first surface of the substrate. Figure 1(g).

Claim 15: the external section comprises a bump. Figure 1(g).

'875 provides all the features of these claims except that (1) before forming the inner layer an oxide layer is formed on an inner peripheral surface portion of the non-through hole adjacent to the first surface of the substrate and on a portion of the first surface of the substrate adjacent to the non-through hole, such that only the oxide layer is layered on the substrate, (2) filling the hole with molten metal by using decompression chamber as claimed (claim 9), using inert gas for pressurizing (claim 23), (3) filling the hole with molten metal by immersing the substrate in molten metal (claim

10), and (4) then solidifying the metal by discharging the substrate from the molten metal (claim 11).

However, Amano teaches that when providing semiconductor substrates with non-through holes to which metal filling is provided, it is well known to provide a first layer of oxide (insulation film 22 of silica) directly on the substrate in the hole (concave) area and on a portion of the substrate adjacent this area. Figure 2 and column 4, line 40 through column 5, lines 35. Then a metal film 23 is provided directly on the insulation film 22 in the hole (concave) area and a portion of film 22 adjacent the hole area. Column 5, lines 25-35 and figure 2. Then, over that area the metal filling area 26 is provided. Column 5, lines 5-15.

Schneble teaches a metal filling method. Column 4, lines 40-75. A hole is formed in a work piece extending from a first surface towards and opposite surface of a work piece. Column 4, lines 55-60 (holes 28) and figure 1E. The hole extends "into" base 10, and is not required to pass entirely through the substrate (base). Column 4, lines 55-50 and Figure 1. Then a metal layer is formed on at least an inner surface of one end of the hole adjacent the first surface of the work piece. Column 4, lines 55-65 (deposit 30) and figure 1F. The metal layer is also formed on a portion of the first surface of the work piece adjacent the hole, and thus is directly adhered to the first surface of the work piece adjacent the hole. Column 4, lines 60-70, column 5, lines 5-15 and figure 1F (land 32 on the top of mask layer 26 of the work piece, note that the hole is formed in a "work piece" that has base 10 and layers 22, 24, 26 as shown in figure 1E, and thus the top of

mask layer 26 is the "first surface" of the work piece; to which the metal layer is directly adhered to (stuck fast or attached) until the layer 26 is actually removed as in figure 1G, column 4, lines 65-70). Then a third step of filling a molten metal into the fine hole is provided. Column 4, lines 65-75, column 5, lines 25-30 (solder would be metal) and Figure 1H (see 34). These form conductive passageways (connectors). Column 2, lines 40-50. The hole is filled by immersing the work piece in molten metal. Column 2, lines 1-10, column 4, lines 65-75, column 5, lines 20-60 (dipping in a molten solder bath). The solder metal comprises an external section which protrudes from the first surface of the work piece, forming a "bump" shape. Figure 1H and column 4, lines 70-75.

'191 teaches that a known way of filling in metal in fine pores (non through holes) in substrates is to provide a molten metal tank in a vacuum (decompression) chamber, reduce the pressure in the chamber, immerse the substrate in the molten metal tank, and then pressurizing the chamber to fill the molten metal into the pores without generating an air gap in the pores. Abstract, figures 3-4, and paragraphs [0012]--[0013]. This will provide relatively reducing pressure in the hole compared to a pressure outside the hole. After filling the substrate is removed and the molten metal allowed to cool, which would solidify the metal. Paragraph [0014]. '191 teaches that the pressurizing of the chamber can be by feeding (introducing) nitrogen (understood to be inert, as applicant uses nitrogen as inert gas, see page 18 of the present specification) into the chamber (paragraph [0013]).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 to provide an oxide insulation film in the non-through hole and adjacent the non-through hole, directly on the substrate and under the area where the metal layer is provided as suggested by Amano with an expectation of providing a desirable insulation between the semiconductor substrate and the metal layer as '875 teaches providing a metal layer between a semiconductor substrate and filled metal of a hole area and Amano teaches that when providing a metal layer between a semiconductor substrate and filled metal of a hole area it is well known to further provide an oxide insulation layer between the semiconductor substrate and the metal layer. It would further have been obvious to modify '875 in view of Amano to provide the metal filling method by immersing the work piece in molten metal as suggested by Schneble with an expectation of desirable metal filling results, because '875 in view of Amano provides filling metal in a non-through hole after the hole area has an oxide layer followed by a metal layer; and Schneble provides a known way to fill a non-through hole with a metal layer on the inside with a metal fill. It would further have been obvious to modify '875 in view of Amano and Schneble to further remove the work piece from the molten metal bath and solidify the molten metal, in order to have a desirable treated substrate for use, because '875 in view of Amano and Schneble teaches to dip the article in molten metal, and demonstrates the result of a plated and filled article, indicating that the article must be removed from the molten metal bath for final use and furthermore the molten metal would solidify after removed from the bath,

because it was no longer heated. Moreover, it would further have been obvious to modify '875 in view of Amano and Schneble to provide the immersion filling process by providing the molten metal in a decompression chamber, reducing the pressure in the chamber, then immersing the substrate in the molten metal, and then after immersion, pressurizing the chamber with inert gas so that the molten metal flows into the inside of the hole, and then removing the substrate and allowing the molten metal to solidify as suggested by '191 in order to provide desirable impregnation of the holes, because '875 in view of Amano and Schneble provides impregnation of molten metal into the holes by immersion, and '191 teaches that when impregnating a molten metal into a substrate with pores (holes) by immersion, it is known to provide the filling process by providing the molten metal in a decompression chamber, reducing the pressure in the chamber, then immersing the substrate in the molten metal, and then after immersion, pressurizing the chamber with inert gas in the form of nitrogen so that the molten metal flows into the inside of the hole, and then removing the substrate and allowing the molten metal to solidify, allowing efficient filling of pores.

15. Claims 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano, Schneble and '191 as applied to claims 9, 11, 13-15 and 23 above, and further in view of Ishikawa et al (US 3599601).

'875 in view of Amano, Schneble and '191 teaches all the features of these claims except (1) the solidifying of the molten metal in the chamber where the inert gas is fed

(claim 24) and (2) lifting the substrate from the molten metal so that metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor (claim 25).

Ishikawa provides an immersion process for filling pores (holes) of a porous substrate with molten metal (column 1, lines 5-10), where molten metal is provided in a vessel (decompression chamber), the pressure is reduced in the chamber, the substrate is then lowered into the molten metal, thus immersing the substrate in the molten metal (column 4, lines 20-40, figure 4), followed by pressurizing the chamber to provide for impregnation of the substrate (column 4, lines 40-50). The pressurizing the chamber is done by feeding inert gas under pressure into the chamber (column 4, lines 40-50), with the inert gas preventing the metal and substrate from oxidizing (column 4, lines 20-30). After impregnation, the substrate is lifted from the molten metal and can be cooled in the chamber while under pressure to prevent molten metal from exuding therefrom (column 4, lines 45-65, figure 5). The lifting of the substrate out from the molten metal allows excess metal attached thereto to be removed (column 4, lines 50-55).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano, Schneble and '191 to cool the substrate in the chamber where the inert gas is fed as suggested by Ishikawa in order to allow a desirably cooling under pressure to help prevent molten metal from exuding therefrom, since '191 provides a desirable impregnating process for the substrate holes using immersion in molten metal under pressure in a chamber, and Ishikawa teaches

that after lifting the substrate with impregnated molten metal from being immersed in a molten metal bath under pressure in a chamber, the substrate can remain in the chamber to cool under pressure to prevent molten metal from exuding therefrom, and such cooling would be suggested to cause solidification, such that no more exuding can occur. It further would have been obvious to one of ordinary skill in the art to modify '875 in view of Amano, Schneble and '191 to provide that the lifting out of the substrate provides that molten metal drops off in areas other than the metal layer where the wettability of the molten metal with respect to the substrate is poor as suggested by Ishikawa, in order to provide a desirably coated article, because '191 teaches lifting the substrate out of the molten metal bath after immersion and impregnation (figure 2, paragraph [0014]), and Ishikawa shows that when lifting a substrate out of a molten metal bath after immersion in a molten metal bath under pressure to impregnate, it is well known for excess metal attached thereto to be removed, that is, drops off, which indicates that the area from which it drops off from the substrate would have poor wettability to the extent claimed (note the 35 USC 112 confusion as to what is required by poor wettability), and further given the suggested use of a semiconductor substrate such as GaAs by both '875 and applicant (page 12 of the specification), it would also be expected that the same poor wettability and metal drop off would occur, since, "Products of identical chemical composition can not have mutually exclusive properties." A chemical composition and its properties are inseparable. Therefore, if the prior art teaches the identical chemical structure, the properties applicant discloses

and/or claims are necessarily present. In re Spada, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990).

16. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano, Schneble and '191 as applied to claims 9, 11, 13-15 and 23 above, and further in view of Locke et al (US 5245751).

'875 in view of Amano, Schneble and '191 teaches all the features of this claims except that the hole is a through hole that extends through the work piece (claim 26 by way of claim 16) and that the metal filling method further comprises closing the opening of the through holes and then opening the closed opening (claim 26 by way of claim 16). '191 teaches that the decompression chamber is pressurized by feeding nitrogen (understood to be inert, as applicant uses nitrogen as inert gas, see page 18 of the present specification) in to the chamber (paragraph [0013]).

Locke teaches that it is well known to provide connector through holes in an article where the holes are to be filled with metal. Column 4, lines 5-20. Locke teaches that it is known to form the connectors by providing a via or hole 82 that extends partially into a substrate (layer 80) of a work piece. Figure 6a and column 8, lines 20-30. Then the hole is plated to fill with conductor metals. Figure 6b and column 8, lines 25-35. Then the substrate 80 is partially removed to expose the metal in the hole by a process such as etching. Figure 6c and column 8, lines 35-40. Solder can be plated into the holes. Column 8, lines 40-45. Locke also teaches that it is known to form the

connectors by providing a through hole 58 through a substrate (sheet 56) and to close/block/seal the hole using a layer 54 (copper foil). Figure 5a and column 7, lines 40-47. Then the hole is plated to fill with conductor metals. Column 7, lines 45-55 and figure 5b. Then the layer 54 is removed to expose the metal through the opening of the through hole. Figure 5c and column 7, lines 54-60.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano, Schneble and '191 to provide a through hole that extends through the entire work piece but is blocked by a sealing layer (closing one side of the opening) to allow desirable filling and then to open the closed opening by removing the sealing layer as suggested by Locke in order to provide desirable connectors, because '875 in view of Amano, Schneble and '191 teaches to provide holes into the substrate to be filled with metal and that the holes will become through holes and Locke teaches that when providing connector holes, it is known to provide them as a through hole that extends through the entire work piece but is blocked by a sealing layer (closing one side of the opening) to allow desirable filling, and then to open the closed opening by removing the sealing layer, which would provided an equivalent through hole system result to that provided by '875 in view of Amano, Schneble and '191. It would have been obvious to that the sealing layer would be provided either before or after hole formation with an expectation of equivalent results as long as it was provided before the filling of the holes, because the purpose of the sealing layer is to block the opening during filling. Also note *In re Burhans*, 154 F.2d

690, 69 USPQ 330 (CCPA 1946) (selection of any order of performing process steps is prima facie obvious in the absence of new or unexpected results) (MPEP 2144.04. IV. C).

17. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over '875 in view of Amano, Schneble, '191 and Locke as applied to claim 26 above, and further in view of Ishikawa et al (US 3599601).

'875 in view of Amano, Schneble, '191 and Locke teaches all the features of this claims except the solidifying of the molten metal in the chamber where the inert gas is fed.

Ishikawa provides an immersion process for filling pores (holes) of a porous substrate with molten metal (column 1, lines 5-10), where molten metal is provided in a vessel (decompression chamber), the pressure is reduced in the chamber, the substrate is then lowered into the molten metal, thus immersing the substrate in the molten metal (column 4, lines 20-40, figure 4), followed by pressurizing the chamber to provide for impregnation of the substrate (column 4, lines 40-50). The pressurizing the chamber is done by feeding inert gas under pressure into the chamber (column 4, lines 40-50), with the inert gas preventing the metal and substrate from oxidizing (column 4, lines 20-30). After impregnation, the substrate is lifted from the molten metal and can be cooled in the chamber while under pressure to prevent molten metal from exuding therefrom (column 4, lines 45-65, figure 5). The lifting of the substrate out from the molten metal allows excess metal attached thereto to be removed (column 4, lines 50-55).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify '875 in view of Amano, Schneble, '191 and Locke to cool the substrate in the chamber where the inert gas is fed as suggested by Ishikawa in order to allow a desirably cooling under pressure to help prevent molten metal from exuding therefrom, since '191 provides a desirable impregnating process for the substrate holes using immersion in molten metal under pressure in a chamber, and Ishikawa teaches that after lifting the substrate with impregnated molten metal from being immersed in a molten metal bath under pressure in a chamber, the substrate can remain in the chamber to cool under pressure to prevent molten metal from exuding therefrom, and such cooling would be suggested to cause solidification, such that no more exuding can occur.

18. The Examiner notes the provision of Japan 2002-158191 with the IDS of January 15, 2009. The Examiner notes that Ishikawa was provided on the PTO-892 provided with the Office Action of June 9, 2010.

Priority

19. The Examiner has reviewed the submitted certified translations of the foreign priority documents, but the rejection of claims 9, 11, 13-15 and 23-27 using Japan 2002-158191 (hereinafter '191) as provided above is not overcome. This is because priority document 2001-287082, which has a filing date before the effective date of '191 does not

provide a teaching of performing the metal filling method for filling "non-through holes" as claimed in claims 9-11, 13-15 and 23-25, but rather only describes the use of "through holes" as in claims 16-18, 20-22 and 28 (since priority document Japan 2001-287082 provides a teaching of all the features of claims 16-18, 20-22 and 28 the rejection using '191 has been withdrawn for these claims), and as to claims 26 and 27, does not provide the inert gas or solidification features of these claims. Since all the features of claims 9-11, 13-15 and 23-27 are not provided by the priority document 2001-287082, the chain of priority does not extend back to the filing date of 2001-287082 and the rejection using '191 is maintained and further rejections are provided for new claims 23-27. While the second priority document, to 2002-270563 does provide a teaching of performing the metal filling method for "non-through holes", this document cannot be used to overcome the rejection using '191, because the publication date of '191 (May 31, 2002) is before the filing date of 2002-270563 (September 17, 2002).

Response to Arguments

20. Applicant's arguments filed December 9, 2010 have been fully considered but they are not persuasive.

(A) As to the 35 USC 103 rejection using '875 in view of Amano, Schneble and Stynes, applicant argues that '875 and Amano do not disclose the filling features using the decompression chamber, and Schneble does not disclose the non-through hole, oxide layer and filling features using the decompression chamber. The Examiner notes

the arguments as to these references, but as to the filling features using the decompression chamber, Styne was provided as to the suggestion of these features, and as to the hole features and oxide layer '875 and Amano were provided (the Examiner also notes that Scheble requires the hole to extend into the base 10, not that necessarily be a through hole). One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). As to the use of Styne, applicant argues that Styne does not disclose a non-through hole, or the metal layer on the oxide layer. As to the non-through hole, applicant argues that because in Styne both ends are open, a gas inside the hole is pushed towards the middle of the through hole, so that a void is generated, which is prevented by the present invention, and since Styne does not disclose or suggest the above described features, there is no motivation to combine Styne with the other citations. The Examiner has reviewed these arguments, however, the rejection is maintained. As to Styne not disclosing the metal layer on the oxide layer, the references to '875 and Amano are provided as to this feature. Styne is provided as to a desirable way to immerse molten metal into a substrate with holes provided therein, which holes would be provided by the combination of '875 and Amano, and would be relevant as '875 and applicant are concerned with filling holes with metal, as well. As to Styne not teaching to provide a non-through hole, the Examiner disagrees. A reading of Styne indicates that the holes can be through holes

or not-through holes and still provided with desirable immersion using the decompression chamber method. See column 5, lines 20-30, access through the top and/or bottom by way of the holes (if only from one not a through hole), and column 13, lines 35-60, where holes pass through the top and/or the bottom, that is, access can be only from the top or bottom, and thus not a through hole, and Figures 20, 21, see leads/holes marked 143, 144, for example, which are shown without through passage, column 13, lines 20-25. Since Styne would indicate that non-through holes can be desirably impregnated with molten metal by the immersion using the decompression chamber as described, it would provide a desirable impregnation method for the non-through hole filling needed by '875, for example, thus providing motivation to combine for the reasons discussed in the rejection above, and moreover, applicant's arguments that gas would be pushed from both ends towards the middle of the through hole in Styne would not apply when the non-through hole option is used. Applicant argues that there is no motivation or reason to combine the citations with each other and no reasonable expectation of success, however, other than the previously discussed features as to Styne, no arguments are provided as to why there would be no motivation to combine or reasonable success in combining, and therefore, applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. The Examiner has clearly pointed out the motivation to combine in the rejection above, and

applicant has pointed out no specific reasons other than as to the use of Stynes (which has been addressed above) as to why this is in error, and therefore the rejection is maintained.

(B) As to the 35 USC 103 rejection using '875 in view of Amano, Schneble, Stynes and Locke, applicant argues that '875, Amano and Schneble do not disclose the closing of the opening, and filling features using the decompression chamber, Stynes does not disclose the metal layer formed on the oxide layer, and the closing of the opening, and Locke does not described the filling features using the decompression chamber. The Examiner notes the arguments as to these references, but as to the filling features using the decompression chamber, Stynes was provided as to the suggestion of these features, and as to the oxide layer '875 and Amano were provided. Locke was provided as to the closing of the opening. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Furthermore, as to Stynes having both ends of the through hole open, the Examiner notes that as discussed in section (A) above, Stynes also allows for non through holes to be impregnated. Applicant argues that there is no motivation or reason to combine the citations with each other and no reasonable expectation of success, however, no arguments are provided as to why there would be no motivation to combine or reasonable success in combining, and therefore, applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the

claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. The Examiner has clearly pointed out the motivation to combine in the rejection above, and applicant has pointed out no specific reasons other than that the different references do not each teach all the features of the invention, which does not point out how the claim language distinguishes from the combination of references.

(C) As to new claims 23-28, the Examiner has provided Ishikawa in combination with '875, Amano, Schneble and Stynes (for claims 23-25) and with '875, Amano, Schneble, Stynes and Locke (for claims 26-28) as discussed in the rejections above.

(D) As to the 35 USC 103 rejection using '875, Amano, Schneble and '191, applicant argues that '191 does not disclose a metal layer formed on the inner peripheral surface portion of the non-through hole adjacent the first surface of the substrate and the oxide layer as claimed, and therefore a plating solution tends to leak out and filling of the plating solution cannot be carried out reliably, and '191 does not make up for the deficiencies of '875, Amano and Schneble, and as well, applicant argues that there is no motivation or reason to combine the citations with each other and no reasonable expectation of success. The Examiner has reviewed these arguments, however, the rejection is maintained. As to the suggestion to provide the metal layer and oxide layer as claimed, this is provided by '875 and Amano. While '191 does not teach the specific layer system, it is provided as to a desirable method for impregnation the molten metal. As previously noted, one cannot show nonobviousness by attacking

references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Applicant argues that there is no motivation or reason to combine the citations with each other and no reasonable expectation of success, however, no arguments are provided as to why there would be no motivation to combine or reasonable success in combining, and therefore, applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. The Examiner has clearly pointed out the motivation to combine in the rejection above, and applicant has pointed out no specific reasons other than that the different references do not each teach all the features of the invention, which does not point out how the claim language distinguishes from the combination of references.

(E) As to new claims 23-27, the Examiner notes that '875, Amano, Schneble and '191 provide the inert gas features of claim 23 and Ishikawa has been further provided as to claims 24-25, and Locke has been further provided as to claim 26 (since priority does not extend back to the Japanese priority document 2001-287082 for this claim as noted in paragraph 19 above) and with Ishikawa further provided along with Locke for claim 27.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Katherine A. Bareford whose telephone number is (571) 272-1413. The examiner can normally be reached on M-F(6:00-3:30) First Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy H. Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Katherine A. Bareford/
Primary Examiner, Art Unit 1715